Claims :

I claim;

1. A structural beam elongated in a first direction and transverse to said direction of elongation comprising; two flanges joined by a web, said web being substantially perpendicular to said flanges and joining said flanges roughly at a central point, and

   at least two angle sections, each said angle section connected to said web proximal to a near flange and forming an acute angle to the portion of said web closest to said near flange,

   said near flange and each of said at least two angle sections forming a roughly dovetail shaped channel with an aperture opening into an interior cavity,

   said dovetail shaped channel having a seal surface on one side, a lock surface roughly opposed to said seal surface on the other side and having a bottom section facing said aperture and connecting said seal surface with said lock surface;

   whereby, a number of larger structures with integral connection to said structural beams with a variety of energy saving features can be constructed.

2. The structural beam of claim 1, further including bulb enlargements at the edges of said flanges.

3. The structural beam of claim 1, wherein said near flange, said bottom section(s) and said angle section(s) comprise a flange module composed a first material and said web is composed of a second material, further including, module attachment means for securing said flange module to said web.

4. The structural beam of claim 3, wherein said first material comprises an aluminum extrusion and said second material comprises a composite having fibrous reinforcement bonded within a resin matrix; whereby, the exterior of a structure can be thermally isolated from the interior.

5. The structural beam of claim 1, wherein said structural beam has four angle sections.

6. The structural beam of claim 1, wherein two of said structural beams make up a pair of spaced apart, side rails comprising an openwork frame,

   said openwork frame further including; a plurality of cross members spanning said side rails and attachment means for securing said cross members to said pair of side rails,

   said openwork frame having a first plane roughly delineated by a first pair of flanges, one from each of said side rails, and those cross members joining said first pair of flanges, and

   having a second plane roughly delineated by the remaining pair of flanges, one from each of said side rails, and those cross members joining said remaining pair of flanges.

7. The openwork frame of claim 6, further including an exterior skin attached to said first plane and an interior skin attached to said second plane, said exterior skin and said interior skin comprising

relatively thin sheet materials having two roughly parallel surfaces,

said exterior skin being attached to said first plane on a frame surface and having an exterior surface on the opposite side

said exterior skin being formed around the ends of said first pair of flanges and attached to said seal surfaces of said dovetail shaped channels,

said interior skin being formed around the ends of said remaining pair of flanges and attached to said seal surfaces of said dovetail shaped channels, and

additionally including end caps and end sealing means affixed to the ends of said frame, and

other appropriate panel sealing means,

said openwork frame, said exterior skin, said interior skin, said end caps, said end sealing means and said panel sealing means comprising a building panel and enclosing an interior cavity.

8. The building panel of claim 7, wherein said exterior skin and said interior skin are composed of thin gauge metal, and

further including insulating means filling said interior cavity,

said building panel and said insulating means comprising an insulating panel.

9. The insulating panel of claim 8, wherein said insulating means comprise; a fibrous fire retardant thermal insulation material and a gas having a thermal conductivity lower than that of air;

whereby, improved insulating features and fire safety can be achieved without using polymer foams.

10. The insulating panel of claim 8, wherein just two of said at least two angle sections on each of said pair of side rails are situated on the same side of said web and outside of said interior cavity, and

wherein, said just two angle sections form two of said dovetail shaped channels, with the dovetail shaped channel closest to said first plane being designated as a seal channel and the dovetail shaped channel closest to said second plane being designated as a structural channel.

11. The insulating panel of claim 10, said insulating panel further including;

a plenum cover affixed to and spanning said just two angle sections on each of said pair of side rails and forming a plenum between said plenum cover, said web and said just two angle sections,

with a first plenum being designated as a supply plenum and a second plenum being designated as a return plenum,

fluid transfer means to connect said supply plenum with said return plenum and to contain a heat transfer fluid, and

fluid displacement means for supplying said heat transfer fluid to said supply plenum, for causing said heat transfer fluid to flow between said supply plenum and said return plenum, through said fluid transfer means, and for removing said heat transfer fluid from said return plenum,

said insulating panel, said plenum covers, said supply plenum, said return plenum, said fluid transfer

means, said heat transfer fluid, and said fluid displacement means comprising a heat transfer panel;

whereby said heat transfer fluid can be used to effectively collect energy from or dissipate energy to; the immediate environment of said heat transfer panel.

12. The heat transfer panel of claim 11, wherein;

said insulating means comprise; fire retardant thermal insulation, an insulation facing bonded to said thermal insulation on the side nearest said frame surface, and a roughly planar space between said insulation facing and said frame surface, and wherein;

said fluid transfer means comprise; said planar space, a series of manifold holes passing through those angle sections forming said seal channels, said seal channels, closure means for sealing said apertures of said seal channels, and a series of through holes through said bottom sections and said webs of said seal channels;

whereby, said heat transfer fluid can exchange heat transmitted through said exterior skin by convective heat transfer with said frame surface.

13. The heat transfer panel of claim 12, a plurality of said heat transfer panels forming a thermal storage tank in the form of a multi-sided cylinder, said exterior skins of said heat transfer panels forming most of the perimeter of a fluid containment space,

said thermal storage tank further including;

tank support means for providing a base and a bottom for said thermal storage tank,

sealing means for mechanically engaging said seal channels, providing said closure means and completing a liquid tight seal between said seal channels,

tank base anchorage means securing and sealing said panels against said tank support means,

a thermal storage media contained within said fluid containment space and bounded by said exterior skins, said tank support means and said sealing means, and

bracket means for engaging said structural channels, maintaining a fixed spacing between said heat transfer panels and resisting an outward force caused by said thermal storage media;

whereby, said thermal storage tank can serve to condition said thermal storage media at one point in time using said heat transfer fluid and serve at a later point in time as a thermal energy reservoir.

14. The heat transfer panel of claim 12, further including;

a photocell array covering at least part of said exterior surface, and electricical connection means for collecting an electrical output from said photocell array, and connecting said electrical output to an output device, and wherein;

said fluid transfer means further includes; a capillary film covering said photocell array and said exterior surface, with said capillary film further extending into said seal channels,

said capillary film having riser means for bonding to said exterior surface and said photocell array in a

distributed pattern and maintaining a fluid transfer channel between said capillary film and said photocell array in areas where said riser means are not bonded,

said heat transfer panel, said photocell array, said electrical connection means, said output device, said capillary film, said riser means, and said fluid transfer channel comprising a photovoltaic panel;

whereby, concentrated sunlight impinging on said photovoltaic panel can generate electricity and said fluid displacement means can remove excess heat, preventing damage to said photocell array.

15. The building panel of claim 7, wherein said exterior and interior skins are composed of light transmitting materials, and wherein;

just two of said at least two angle sections on each of said pair of side rails are situated on the same side of said web and outside of said interior cavity,

said building panel further including;

a plenum cover affixed to and spanning said just two angle sections on each of said pair of side rails and forming a fluid plenum between said plenum cover, said web and said just two angle sections,

with a first plenum being designated as a supply plenum and a second plenum being designated as a return plenum,

fluid transfer means to connect said supply plenum with said return plenum, to contain a heat transfer fluid, and to remove heat from said interior cavity, and

fluid displacement means for supplying said heat transfer fluid to said supply plenum, for causing said heat transfer fluid to flow between said supply plenum and said return plenum, through said fluid transfer means, and for removing said heat transfer fluid from said return plenum,

said building panel, said plenum covers, said supply plenum, said fluid transfer means, said return plenum and said fluid displacement means comprising; a daylighting panel;

whereby, ambient natural light can be transmitted through said daylighting panel to illuminate the interior of a structure and heat formed from attenuated light can be removed from said daylighting panel by said heat transfer fluid.

16. The daylighting panel of claim 15, wherein each of said pair of side rails has four angle sections, said angle sections situated within said interior cavity being designated bracket angles,

further including adjustable light attenuation means for setting a desired light transmission level through said daylighting panel, said light attenuation means mounted to said bracket angles, and actuator control means for adjusting said light attenuation means based on a control signal.

17. The daylighting panel of claim 16, wherein a multiplicity of said daylighting panels make up at least part of the sheathing of a building structure, and

said multiplicity of daylighting panels comprise a lighting control system,

said lighting control system further including; exterior sensor means for analyzing ambient light conditions at the outside of said building structure, and for providing outputs to other parts of said lighting control system,

electrical lighting plant means for energizing and controlling luminaires that provide artificial lighting within said building structure,

interior sensor means, for analyzing interior light levels within said building structure, and supplying a feedback signal to a lighting controller, and

said lighting controller having calculational means to 1) compare the outputs of said exterior sensor means with a solar model for the site that includes predicted weather conditions, 2) control said interior light levels to a desired lighting setpoint supplied by a human operator, 3) provide an output signal for actuation by said electrical lighting plant, 4) provide said control signal to said actuator control means of said multiplicity of daylighting panels through a daylighting plant, and 5) minimize electrical usage for said artificial lighting within said building structure.

18. The heat transfer panel of claim 11, wherein said exterior surface has a light absorbing color, and said insulating means comprise a fibrous fire retardant thermal insulation material and a gas having a thermal conductivity lower than air, and

wherein said fluid transfer means comprise; a capillary film covering said exterior surface,

said capillary film having riser means for bonding to said exterior surface in a distributed pattern and for maintaining a fluid pathway between said capillary film and said exterior surface in areas where said riser means are not bonded,

said fluid transfer means further including, piping means for connecting said supply plenum and said return plenum to said fluid pathway,

said heat transfer panel, said insulation material, said gas, said capillary film, said riser means, said fluid pathway and said piping means comprising a solar panel,

said solar panel being capable of operation in a heating mode and a cooling mode,

whereby, in said heating mode, light absorbed by said exterior surface and said capillary film can be captured as useful energy by said heat transfer fluid, and whereby heat contained in said heat transfer fluid can be dissipated through said capillary film in said cooling mode.

19. The openwork frame of claim 6, wherein at least two of said openwork frames make up a structural column,

said structural column further including; a first connector means for engaging said at least two openwork frames at said first pair of flanges and securing said at least two openwork frames one to another,

a second connector means for engaging said at least two openwork frames at said remaining pair of

flanges, and securing said openwork frames one to another, and

end attachment means for securing the ends of said structural column to a set of components making up a larger assembly.

20. The building panel of claim 7 , wherein just two of said at least two angle sections on each of said pair of side rails are situated on the same side of said web and outside of said interior cavity, and

wherein, said just two angle sections form two of said dovetail shaped channels, with the dovetail shaped channel closest to said first plane being designated as a seal channel and the dovetail shaped channel closest to said second plane being designated as a structural channel,

a plurality of said building panels being arrayed parallel to one another and forming a sheathing assembly for a structure having a demand side management (DSM) system for the control of energy usage,

said structure having a frame made up of girders and columns, said girders and columns having attachment flanges for securing said sheathing assembly, said attachment flanges each having a periodic series of holes,

said sheathing assembly including a multiplicity of structural connector means, each of said structural connector means having a first and a second configuration,

said structural connector means being capable of placement between and aligning adjacent building panels in said first configuration and said structural connector means engaging said structural channels of said adjacent building panels and said holes in said second configuration, and securing said building panels to said attachment flanges in the areas where said building panels traverse said girders and columns,

said sheathing assembly further including flexible connector means for weather sealing and mechanically connecting said seal channels of said adjacent building panels to one another,

said DSM system comprising; insulating means, daylighting means and heat exchange means incorporated within said building panels making up one or more of said sheathing assemblies,

said DSM system including; energy exchange loop means for circulating a heat transfer fluid between said heat exchange means and a thermal storage tank containing a thermal storage media and hvac loop means for circulating said thermal storage media between said thermal storage tank and a space heating and cooling system,

said DSM system further including; control means for operating said energy exchange loop, said hvac loop, said daylighting means and minimizing outside energy demand for the operation of said structure.

21. The photovoltaic panel of claim 14, a plurality of said photovoltaic panels arranged in an ordered array, attached to a structure and comprising a distributed electrical power system,

said power system including; heliostat means for concentrating sunlight on said array, power conditioning means for attaching to said output devices and supplying a standard electrical voltage and frequency to a site power distribution panel,

said power system further including; excess heat collection means for circulating a heat transfer fluid between said photovoltaic panels and a thermal storage tank containing a thermal storage media, thermal conversion means for utilizing the temperature differential between said thermal storage media and a cooler thermal reservoir to generate additional electrical power,

power conditioning circuitry connecting said additional electrical power to said site power distibution panel, a grid connection between said site power distribution panel and an outside source of standard electrical power, and finally, connections between said site power distribution panel and a group of local electrical loads;

whereby, said photovoltaic panels and said heliostat means can reduce the cost of solar electrical power relative to the prior art, and whereby said heat collection means and thermal conversion means can supply electrical power during periods of low sunlight or at night.

22. The thermal storage tank of claim 13, further including;

an intermittent renewable source of heat and circulation means for transferring said heat between said renewable source and said thermal storage media,

a thermal electric generator (TEG) having a warm fluid channel and a cool fluid channel, said TEG having the capability to provide an electrical output to an electrical load,

fluid supply means for producing a flow of said thermal storage media from said thermal storage tank to said warm fluid channel and producing a flow of a cool fluid from a cool fluid reservoir to said cool fluid channel, and

electrical control means for conditioning said electrical output of said TEG to a standard power configuation, for connecting said electrical output to said electrical load, and synchronizing said fluid supply means and the operation of said TEG to said electrical load,

said thermal storage tank, said renewable source of heat, said circulation means, said thermal storage media, said TEG, said electrical output, said electrical load, said fluid supply means, said cool fluid, said cool fluid reservoir, and said electrical control means comprising a renewable energy power system;

whereby, said renewable energy power system can supply electrical power based on said intermittent renewable source of heat during times when said source of heat is not available.